DOE/ID/12584–41
UNC/GJ–HMWP–10

UNC Geotech

Environmental Monitoring Report on the U.S. Department of Energy's Inactive Millsite Facility, Monticello, Utah, for Calendar Year 1988

May 1989

Work performed under
DOE Contract No.
DE–AC07–86ID12584 for the
U.S. Department of Energy

Grand Junction
Projects Office

UNC/GJ-HMWP-10
Distribution Category: UC-511

ENVIRONMENTAL MONITORING REPORT ON THE U.S. DEPARTMENT OF ENERGY'S INACTIVE MILLSITE FACILITY, MONTICELLO, UTAH, FOR CALENDAR YEAR 1988

The U.S. Department of Energy
Grand Junction Projects Office
Idaho Operations Office

May 1989

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY

The inactive Monticello Millsite is located in San Juan County, Utah, just south of the town of Monticello. Environmental monitoring at the site is funded by the Surplus Facilities Management Program (SFMP) and focuses on releases related to preexistent mill tailings. All contaminant discharges result from the leaching of uranium-mill-tailings-related elements by ground water and surface water, and from the release of radon gas and particulate matter into the atmosphere. Pathways facilitating the migration of contaminants from the Monticello site include ground water in the shallow alluvial aquifer underlying the inactive facility, surface water running across the site, and the surrounding atmosphere.

The shallow aquifer underlying the Monticello property is contaminated by uranium mill tailings. Concentrations of uranium, molybdenum, vanadium, selenium, and arsenic exceed 1 milligram per liter (mg/L) in some wells. Montezuma Creek, which flows through the property, has frequently contained contamination at levels exceeding State of Utah water-quality standards for 3-5 kilometers (2-3 miles) downstream of the property. Contamination of the creek results from seeps that issue from the contaminated alluvial aquifer. This seepage has, in the past, caused the uranium concentration in the creek to increase by as much as an order of magnitude; concentrations as high as 0.9 mg/L were detected 30 meters (100 feet) downstream of the Government property in 1984. During 1985, 1986, 1987, and 1988, observed concentrations of uranium, selenium, and molybdenum were lower; however, fewer samples were collected than in previous years and samples were collected when water in the creek was at relatively high levels, which diluted the contaminants. Montezuma Creek is used for both irrigation and livestock watering in the vicinity of the site.

Extensive measurement of radon contamination from the tailings piles was conducted during 1984, 1985, and to a lesser extent during 1986, 1987, and 1988. On-pile, site-boundary, and off-site atmospheric radon measurements, as well as on- and off-pile radon-flux measurements, were taken. Results of these measurements demonstrate that the Environmental Protection Agency (EPA) standard for radon emissions from inactive uranium processing sites is exceeded at all four tailings piles at the Monticello site.

Air particulate monitoring was conducted during 1988 at two on-site locations and at one background location using high-volume Sierra-Anderson model 300 air particulate samplers. So that only the inhalable particles would be collected, 10-micron-size screens were added to the samplers. The maximum airborne concentrations of radium-226, thorium-230, and uranium were all several orders of magnitude below the regulatory limits specified by DOE Order 5480.1. The maximum concentrations of lead were below the EPA limit of 1.5 $\mu g/m^3$ at all measurement locations.

Environmental compliance activities conducted during 1988 were several. The Draft Remedial Investigation/Feasibility Study (RI/FS) was submitted to the Department of Energy in January. Investigations of flora, aquatic life, and cultural resources were conducted in the summer to further characterize the site and assess potential impacts of remedial action. The internal Hazard

Ranking System (HRS) scoring of the millsite continued to undergo evaluation by the EPA for inclusion of the site on the Superfund National Priorities List (NPL); a determination is expected in 1989. A DOE/EPA Interagency Agreement in the form of a Federal Facility Agreement was signed in December.

INTRODUCTION

This report presents results of environmental monitoring activities conducted in 1988 at the inactive uranium millsite in Monticello, Utah. The site is included under the U.S. Department of Energy's (DOE) Surplus Facilities Management Program (SFMP). Monitoring and report preparation were performed by UNC Geotech, the DOE contractor for the Grand Junction Projects Office Facility (GJPO) in Grand Junction, Colorado.

The Monticello Millsite is a 31.6-hectare (78-acre) tract located in San Juan County, Utah, adjacent to the city limits of Monticello. The mill area covers approximately 4 hectares (10 acres), the tailings impoundment area covers the remaining 27.5 hectares (68 acres). None of the original mill buildings remain, but contaminated foundations and scrap materials are buried on site. The tailings impoundment area contains almost 1,814,000 metric tons (2 million short tons), or 1,018,800 cubic meters (1,333,333 cubic yards), of tailings and contaminated soil in four discrete piles. An additional 362,800 metric tons (400,000 short tons), or 203,759 cubic meters (266,666 cubic yards), of contaminated material is present on adjacent open lands (Marutzky and others 1985).

Prior to 1955, the environmental problems receiving attention at the Monticello mill arose from the salt roast procedure used to enhance vanadium recovery. An average of nearly 1182 kilograms (2600 pounds) of dust containing 0.363 percent U_3O_8 and 1.52 percent V_2O_5 escaped daily through the roaster stack (Allen and Klemenic 1954). Corrosion of wire fences, clotheslines, and galvanized roofs was verified by the mill operator in response to complaints from local residents.

Liquid effluent from the salt roast/carbonate leach plant, which contained substantial concentrations of chloride, sulfate, carbonate, bicarbonate, sodium, and other dissolved species, was released into Montezuma Creek. Release of radium-226 was of special concern; soluble radium activity in Montezuma Creek was found to be 160 picocuries per liter (pCi/L). It was also recognized that the suspended solids contained considerable radium activity and that dry tailings were being washed into the creek (Whitman and Beverly 1958).

During milling operations, the tailings were normally moist and erosion by wind was therefore minimal. Within a year after shutdown, however, the tailings dams and surfaces of the piles dried out, and tailings sand began to migrate as dunes. Erosion by water also became a problem. Several cleanup activities conducted since the time of mill closure have substantially stabilized the area but have not eliminated water contamination. Extensive studies conducted at Monticello demonstrate that all four tailings piles contribute to the contamination of ground water and surface water, both on and off site.

Responsibility for the administration, maintenance, and environmental monitoring of the inactive uranium millsite and tailings area at Monticello, Utah, formerly operated by the Atomic Energy Commission, resides with the DOE's GJPO. The site was accepted into the SFMP in 1980. Under this program, the chief objective of the Monticello Remedial Action Project is to minimize

potential health hazards to the public that are associated with the tailings at the millsite. In order to provide a basis for making decisions regarding the remediation of the site, an environmental and engineering characterization was completed and documented in the *Monticello Remedial Action Project Site Analysis Report* (Abramiuk and others 1984). In addition, a Draft Remedial Investigation/Feasibility Study (RI/FS) report was completed in January 1988 (UNC Geotech 1988a); this report is presently in revision.

Previous years of monitoring activity at the Monticello Millsite have clearly defined the contaminant type and distribution in ground water, surface water, and air. Because of the well-defined plume characteristics at the site, monitoring activities were abbreviated in 1988 (as in 1987) to include biannual ground-water and surface-water samplings. Analyses were performed for known contaminants for which standards either exist or are propcsed, i.e., gross alpha, radium-226, radium-228, uranium, vanadium, arsenic, selenium, molybdenum, and nitrate. Total alkalinity, pH, and specific conductance were measured as well to identify any change in the general water-quality characteristics. Ambient air monitoring at the site was conducted as in previous years.

ENVIRONMENTAL MONITORING PROGRAM

REGULATIONS REQUIRING MONITORING

Monitoring activities at the Monticello Millsite are conducted in conjunction with planned remediation activities under CERCLA/SARA. The resultant data will provide extensive baseline information prior to initiation of remediation. Inclusion of the Monticello site on the National Priorities List (NPL) is expected in 1989.

QUALITY ASSURANCE

Quality Assurance (QA) measures were incorporated into all of the monitoring activities detailed in this report, and were appropriately documented. General quality assurance policy and procedures, as presented in the *Quality Assurance Manual* (UNC Geotech/Grand Junction Projects Office 1987a), were followed. Other documents consulted to address QA considerations regarding specific measurement and sample-collection procedures were:

- DOE/GJPO *Handbook of Analytical and Sample-Preparation Methods* (UNC Geotech 1988c);
- DOE/GJPO *Administrative Plan and Quality Control Methods for the UNC/GJPO Analytical Laboratories* (UNC Geotech 1988d);
- UNC/GJPO *Environmental Sciences Procedure Manual*, Second Edition (UNC Geotech 1986); and
- SFMP/Monticello Remedial Action Project (MRAP) Quality Assurance Program Plan (QAPP) (UNC Geotech 1987b).

SOURCES OF CONTAMINATION

Radioactive mill tailings compose the principal waste type at the Monticello millsite. Residual uranium ore at old ore stockpile areas at the millsite constitutes only a minor waste type. Historically, environmental concern has focused on the radiological hazards associated with the tailings and ore. However, a number of trace elements typically occur at elevated concentrations in uranium ore. These are not recovered during milling operations, but are passed through the circuit to the tailings piles. Because hazardous organic chemicals were not used in the milling process, the hazardous substances selected for waste characterization are all inorganic.

According to Albrethsen and McGinley (1982), 819,291 metric tons (903,298 short tons) of uranium ore was processed at the Monticello mill between 1948 and 1960 to yield approximately 2077 metric tons (2290 short tons) of uranium oxide, U_3O_8, and 1061 metric tons (1170 short tons) of vanadium pentoxide, V_2O_5. Most of the original constituents of the ore, as well as the chemicals added during the milling process, reside in the tailings. Therefore, the tailings quantity is estimated to be about 819,021 metric tons (903,000 short tons), or 459,988 cubic meters (602,000 cubic yards).

The tailings generated by the milling operations are contained in four piles referred to, in order of their construction, as the Carbonate Pile, Vanadium Pile, Acid Pile, and the East Pile (Figure 1). The Carbonate and Vanadium Piles were formed during the period from 1949 to 1955 when the mill was recovering vanadium as a by-product. The process used for the recovery was a salt roast/carbonate leach flow sheet. The Vanadium Pile is so called because of the high vanadium content of these tailings; it is in no way related to tailings produced by the Vanadium Corporation of America (VCA) mill that preceded the Atomic Energy Commission (AEC) mill. Use of the Acid Pile commenced about 1955. This pile received tailings from the acid leach resin-in-pulp (RIP) process and a carbonate leach circuit. The East Pile was operated from 1956 until mill shutdown in 1960 and received tailings from the acid leach circuit and the high temperature, carbonate leach RIP circuit.

Photographs taken during the operation of the millsite indicate that earthen berms were initially used to impound the tailings. As the impoundment filled, sandy tailings were apparently used as berm material to maintain the ponds. After closure of the mill, the piles were regraded and stabilized by covering them with pit-run gravel and top soil. The total quantity of tailings, earthen berms, cover material, and contaminated substrate is estimated to be about 1,451,790 cubic meters (1.9 million cubic yards). Materials from all four tailings piles are available for leaching into the ground and surface water and for release into the atmosphere.

GROUND WATER

Hydrogeology

There are two primary aquifers in the project area. Unconsolidated materials deposited by Montezuma Creek constitute an alluvial aquifer along the valley bottom. An underlying sandstone aquifer, the Burro Canyon Formation, is separated from the alluvial aquifer by the Mancos Shale and by shale units of the Dakota Sandstone, which act as a major aquitard in the project area (Figure 2).

The alluvial aquifer is approximately 3 meters (15 feet) thick near Montezuma Creek and thins gradually toward the valley sides. Montezuma Creek is in hydraulic communication with the aquifer on the upstream side of the East Tailings Pile. However, because of a realignment of the stream channel, the aquifer and Montezuma Creek are separated in the vicinity of the East Tailings Pile. The creek and the aquifer are reunited downstream of the tailings pile.

Sources of recharge to the alluvial aquifer are infiltration of precipitation and surface water and seepage from fractures in the Mancos Shale along the boundary of the alluvial aquifer. Discharge from the alluvial aquifer is estimated to be approximately 113,550 to 132,475 liters (30,000 to 35,000 gallons) per day across the East Tailings Pile. Water quality in the alluvial aquifer becomes degraded as it traverses the site by leachate migrating through the tailings. The leachate contributes uranium, vanadium, radium, sulfate, selenium, and molybdenum to ground water in the alluvial aquifer. The alluvial aquifer is not being used for any purpose in the area.

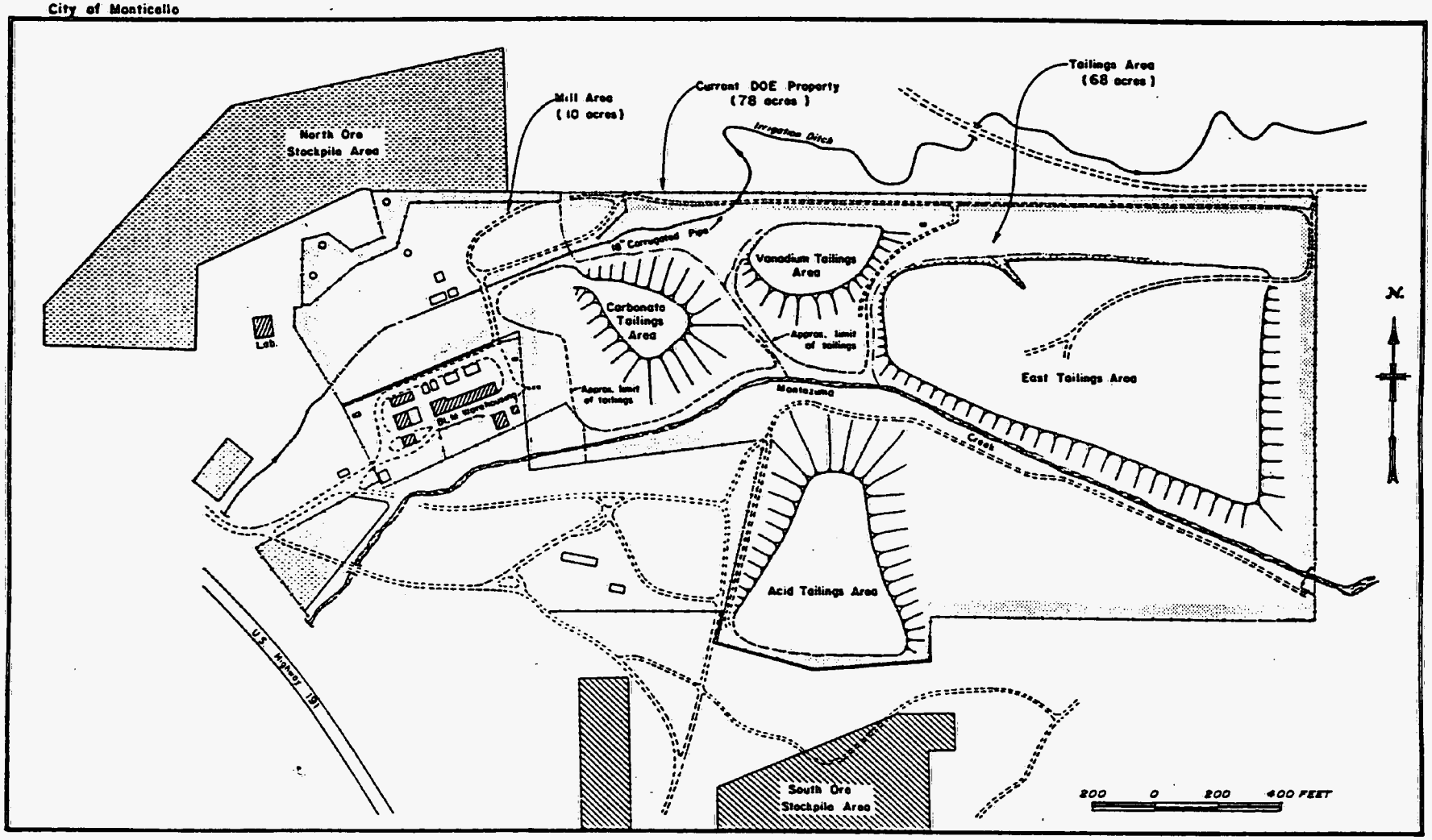

Figure 1. Monticello Millsite Plan

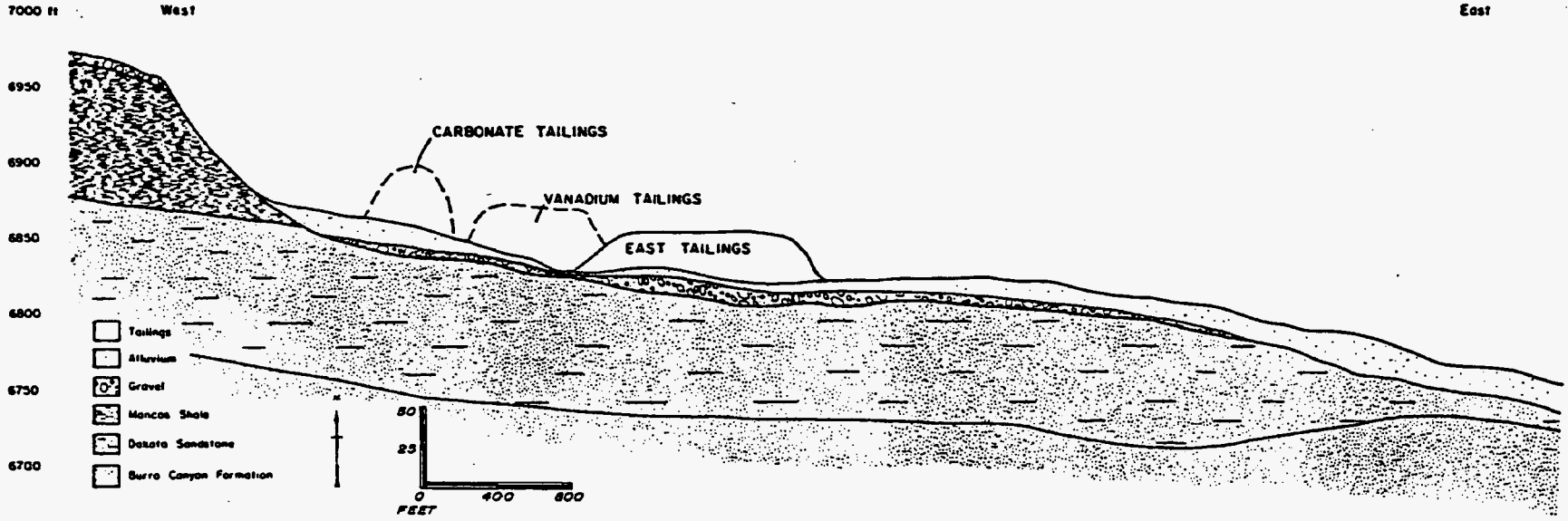

Figure 2. Generalized West-East Cross Section Through the Project Area (Dakota/Burro Canyon based on core data).

The Burro Canyon Formation is a confined aquifer which underlies the alluvial aquifer. It is separated from the alluvial aquifer by an aquitard consisting of the Mancos Shale and silty sandy units of the Dakota Sandstone. The Burro Canyon Formation is tilted and exposed along the margin of the Abajo Dome; this is the recharge zone for the Burro Canyon aquifer. Discharge from the aquifer occurs across the Great Sage Plain, along erosional margins, and in areas where canyons dissect the formation. Numerous stock ponds and marshy areas are created as a result of spring-fed discharge from the Burro Canyon aquifer.

There is presently no evidence that the Burro Canyon aquifer is being degraded by the tailings piles. Water in the Burro Canyon aquifer is used occasionally for domestic water supply.

1988 Sampling and Results

Ground-water samples were collected at the Monticello site in April and October of 1988 using a peristaltic pump, a bladder pump, or a Teflon bailer. Thirteen well samples were collected in 1988. Because the site had been extensively characterized previously, the number of samples was reduced for the 1987 and 1988 calendar years. Samples requiring filtration were run through a 0.45-µm filter in line with the collection vessel. The samples were then preserved as required and analyzed according to procedures prescribed in the *Handbook of Analytical and Sample-Preparation Methods* (UNC Geotech 1988c). The samples were analyzed for those analytes listed in the Appendix. Samples were collected upgradient of the site, on site, and downgradient.

Shallow-aquifer upgradient ground-water-quality data have been acquired from Wells 19, 20, 43, and 44 (Figure 3). Over the past six years, elements not detected or found in very low concentrations include As, Ba, Cl, Fe, Mo, Pb, Se, V, Zn, and Ra-226. Elevated uranium and manganese concentrations have been observed at various times in past analyses. In 1988, only Wells 20 and 43 were sampled: the uranium concentration averaged 0.013 mg/L in Well 20 and 0.021 mg/L in Well 43.

Ground water in the shallow aquifer is contaminated by elements leached from the tailings piles (Tables 1 and 2). In general, the highest concentrations of contaminants are found in the vicinity of the Carbonate and Vanadium Piles. High uranium content is found in Well 36A on the east side of the East Tailings Pile and in off-site Well 1 on private property immediately east of the Government property.

The shallow-aquifer monitoring wells on the private property east of the Government property are contaminated with uranium, molybdenum, vanadium, and selenium. The data presented in previous Environmental Monitoring Reports indicate that concentrations of these elements remain high throughout the year. The aquifer is the major water source for the creek during the dry months and often results in relatively high levels of contamination in Montezuma Creek during those periods. Wells 9 and 13 are located as far east of the Government property as 1 kilometer (0.6 mile) but are still significantly contaminated.

Table 1. Contamination in Shallow On-Site Monitoring Wells

Well	Contaminant Concentration[a]							
	Gross Alpha	As	Mo	NO_3	Ra-226	Se	U	V
30B	336	0.16	0.36	0.7	0.5	0.068	0.60	4.20
36A	2360	0.006	1.06	101.0	14.6	<0.005	5.26	0.18
40A	489	0.05	0.21	<0.2	3.0	<0.005	0.68	0.51
45B	<13	<0.005	<0.05	10.95	0.5	<0.005	0.16	<0.05

[a]All results are in mg/L except those for Ra-226 and Gross Alpha which are in pCi/L. Results represent averages where two samplings were made in 1988.

Table 2. Contamination in Shallow Off-Site Monitoring Wells

Well	Contaminant Concentration[a]							
	Gross Alpha	As	Mo	NO_3	Ra-226	Se	U	V
8	83.5	<0.005	<0.05	2.4	-	0.005	0.143	<0.05
9	299.5	<0.005	0.12	3.1	-	<0.005	0.666	<0.05
13	228.5	<0.005	<0.05	<0.2	-	<0.005	0.483	<0.05

[a]All results are in mg/L except those for Ra-226 and Gross Alpha which are in pCi/L. Results represent averages where two samplings were made in 1988.

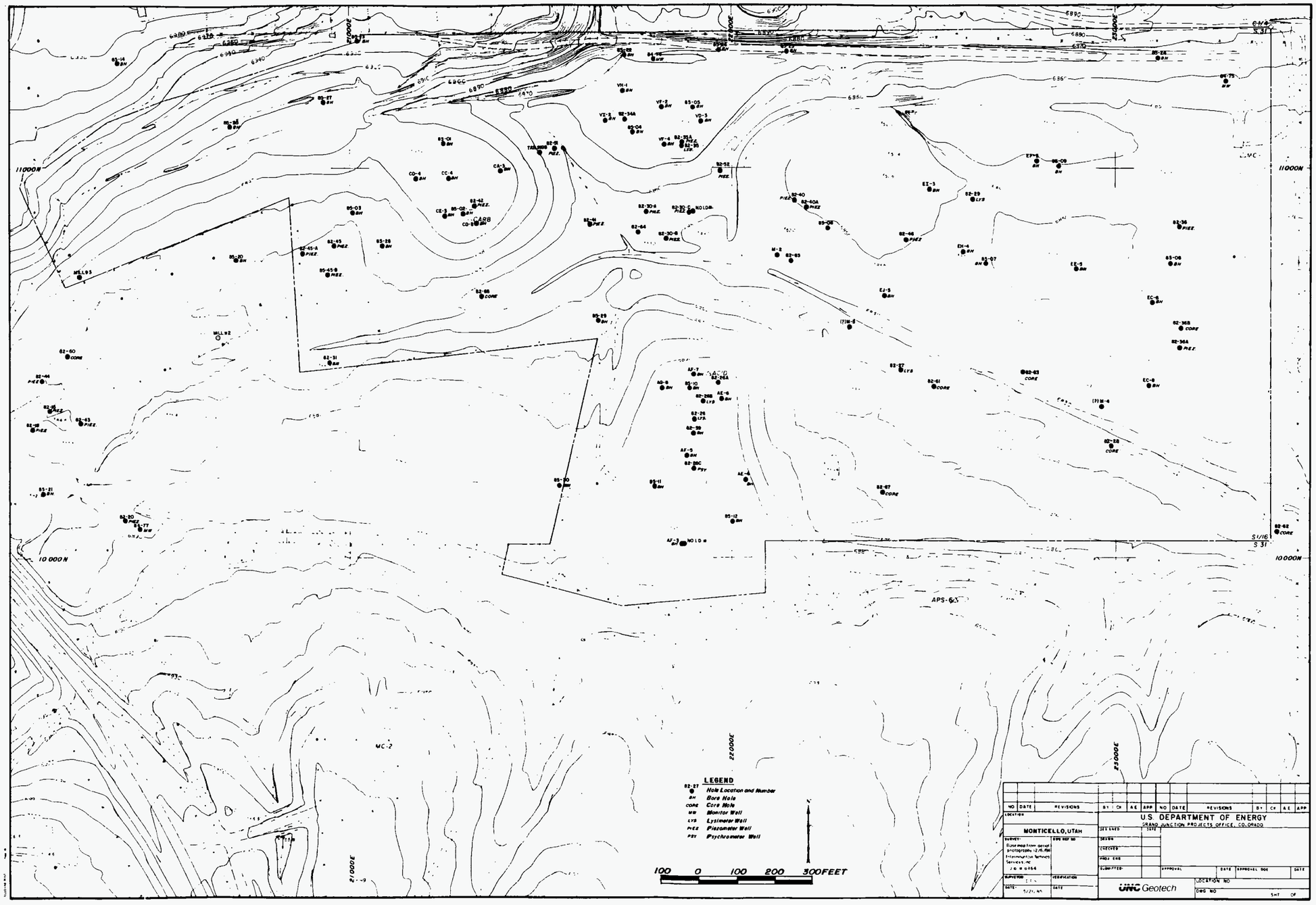

Figure 3. Locations of Ground-Water Monitoring Wells at the Monticello Millsite.

Comparison to Standards

To facilitate the comparison of alluvial aquifer ground-water data to the applicable or relevant and appropriate requirements (ARARs), maximum concentrations were identified from data collected during 1984 to 1988 (UNC Geotech, 1988a). Subsequently, these maximum concentrations were compared to the standards. The ARARs considered for comparison are the Uranium Mill Tailings Radiation Control Act of 1978 Ground-Water Standards and the EPA and State of Utah Drinking Water Quality Standards. The comparisons are presented in Tables 3 and 4. Parameters that exceed their standards are readily identifiable in the tables and include Ra-226, gross alpha, arsenic, selenium, and nitrate. If the proposed new groundwater standards for UMTRCA are adopted, molybdenum and uranium will also exceed standards.

SURFACE WATER

Surface-water monitoring at the Monticello site has provided extensive baseline data over the past seven years. The 1988 monitoring activities were significantly reduced from those of previous years, the primary goal being to detect only major changes in water chemistry. The results did not indicate a change over previous years (see Appendix).

Montezuma Creek is the main surface water body in the project area. Solute concentrations in the creek increase downstream of the site because of the mixing of the creek with alluvial-aquifer discharge. Surface water is used as a source of municipal water supply beginning about 1.6 kilometers (1 mile) upstream of the tailings area. Downstream of the tailings area, surface water is used primarily for stock watering.

Background surface-water quality is monitored at site W-3, shown in Figure 4. This sampling point is located east of the culvert under U.S. Highway 191. In past years, upstream samples (site I-1) have also been collected to verify that the W-3 site accurately represents the background water quality of Montezuma Creek (Korte and Thul, 1982, 1983).

1988 Sampling and Results

Background surface water at site W-3 was characterized by low levels of mill-tailings-related contaminants, an average pH of 7.95, a specific conductance of 1573 µmhos/cm, and an alkalinity of 188 mg/L (as $CaCO^3$). These levels are slightly higher than those of other years because of low runoff during 1988. Previous years of monitoring have shown that elements not detected or found in very low concentrations include As, Ba, Cr, Fe, Mn, Mo, Pb, Se, U, V, and Zn; no Ra-226 has been detected (see Appendix).

Permanent surface water on the Government property consists of perennial flow in Montezuma Creek and in the drainage between the Carbonate and Vanadium Piles (drainage designated W-2 on the map in Figure 4). There is intermittent water in seeps south of the Carbonate and Vanadium Piles and east of the Acid Pile. The Vanadium and Acid Pile seeps contain water in the spring due to the melting of snow. The seep adjacent to the Vanadium Pile generally covers an

Table 3. Comparison of Maximum Concentrations[a] of Selected Constituents in the Alluvial Aquifer at the Monticello Millsite with Uranium Mill Tailings Radiation Control Act of 1978 Ground-Water Standards[b]

Constituent	UMTRCA Standards	Monticello Millsite and Peripheral Properties Maximum Concentration		
		Upgradient	On Site	Downgradient
Arsenic	0.05	0.01	0.19	0.02
Barium	1.0	<0.10	0.85	<0.10
Cadmium	0.01	<0.005	0.005	<0.001
Chromium	0.05	0.01	0.02	<0.01
Lead	0.05	<0.025	<0.025*	<0.01
Mercury	0.002	0.002	<0.0002*	<0.0002
Selenium	0.01	0.013	0.16	0.018
Silver	0.05	<0.025	<0.025*	<0.010
Uranium[c]	--	0.022	12.8	0.80
Endrin (1,2,3,4,10, 10-hexachloro-1, 7-epoxy-1,4,4a,5,6, 7,8,9a-octahyrdo-1, 4-endo, endo-5.8-dimethano naphthalene)	0.0002		<0.012*	
Lindane (1,2,3,4,5, 6-hexachlorocyclohexane, gamma isomer)	0.004		<0.008*	
Methoxychlor (1,1,1, -Trichloro-2,2-bis (p-methoxyphenylethane)	0.1		<0.005*	
Toxaphene ($C_{10}H_{10}Cl_4$ Technical chlorinated camphene, 67-69 percent chlorine)	0.0005		<0.48*	
2,4-D (2,4 Dichloro-phenoxyacetic acid)	0.1		<0.2*	
2,4,5-TP Silvex (2,4,5-Trichlorophenoxypropionic acid)	0.01	NS[d]	NS	NS
Combined radium-226 and radium-226	5	0.20	38.0	<2.0
Gross alpha-particle activity (excluding radon and uranium)	15	15	7280.0	134

[a]All results are in mg/L except for radium and gross alpha, which are in pCi/L. A "<" symbol indicates the maximum concentration was below detection limits (number shown is detection limit). An asterisk (*) indicates that the value applies to all samples. (Based on data collected from 1984-1988.)

[b]40 CFR 192; revised 7/1/86.

[c]The proposed UMTRCA ground-water standards contain concentration limits for uranium. However, these standards have not yet been adopted (as of the time of report preparation).

[d]NS = Not sampled

Table 4. Comparison of Maximum Concentrations[a] of Constituents in the Alluvial Aquifer at the Monticello Millsite with EPA and State of Utah Drinking Water Quality Standards

	Standards			Maximum Concentration			
Constituent	EPA Primary	EPA Secondary	Utah	Up-gradient	On-Site	Down-gradient	EXCEEDS? Yes/No
Arsenic	0.0	--	0.05	0.01	0.19	0.02	Yes
Barium	1.00	--	1.00	<0.10	0.85	<0.10	No
Cadmium	0.01	--	0.01	<0.005	0.005	<0.001	No
Chloride	--	250.00	250.00	17.9	150	1080	Yes
Chromium	0.05	--	0.05	0.01	0.02	<0.01	No
Fluoride	4.00	--	1.6-2.1	0.20	1.2	0.73	No
Iron	--	0.30	0.30	0.60	3	0.81	Yes
Lead	0.05	--	--	<0.025	0.025*	<0.01	No
Manganese	--	0.05	0.05	2.0	21	1.22	Yes
Mercury	0.002	--	0.002	0.002	<0.0002*	<0.0002	No
Nitrate	10.00	--	10.00	18.3	160	4.0	Yes
pH (S.U.)	--	6.5 to 8.5	6.5-8.5	7.5	7.4	7.6	No
Selenium	0.01	--	--	0.013	0.16	0.018	Yes
Silver	0.05	--	0.05	<0.025	<0.025	<0.010	No
Sulfate	250.00	250.00	250.00	682	3900	1200	Yes
Zinc	--	5.00	5.00	2.82	1.40	0.47	No
Ra-226 (pCi/L)	5	--	5	0.20	38	<2.0	Yes
Gross alpha[b] (pCi/L)	15	--	15	15	7280	134	Yes
Organic Constituents (µg/L)							
Endrin	0.2	--	0.2			<0.012*	No
Lindane	4.0	--	4.0			<0.008*	No
Methoxychlor	100.0	--	100.0			<0.005*	No
Toxaphene	5.0	--	--			<0.48*	No
2, 4-D	100.0	--	100.0				--
2,4,5-TP	10.0	--	10.0				--
Phenols	1.0	--	--			<0.01	No

[a]All values in table are given in mg/L except as specifically designated otherwise. Maximum concentrations reported for millsite area are based on 1984-1987 monitoring results. A "<" symbol indicates the maximum concentration was below detection limits (number shown is detection limit); those values followed by an asterisk (*) signify that all samples yielded the stated value.

[b]Gross alpha includes Ra-226 but not radon and uranium activity.

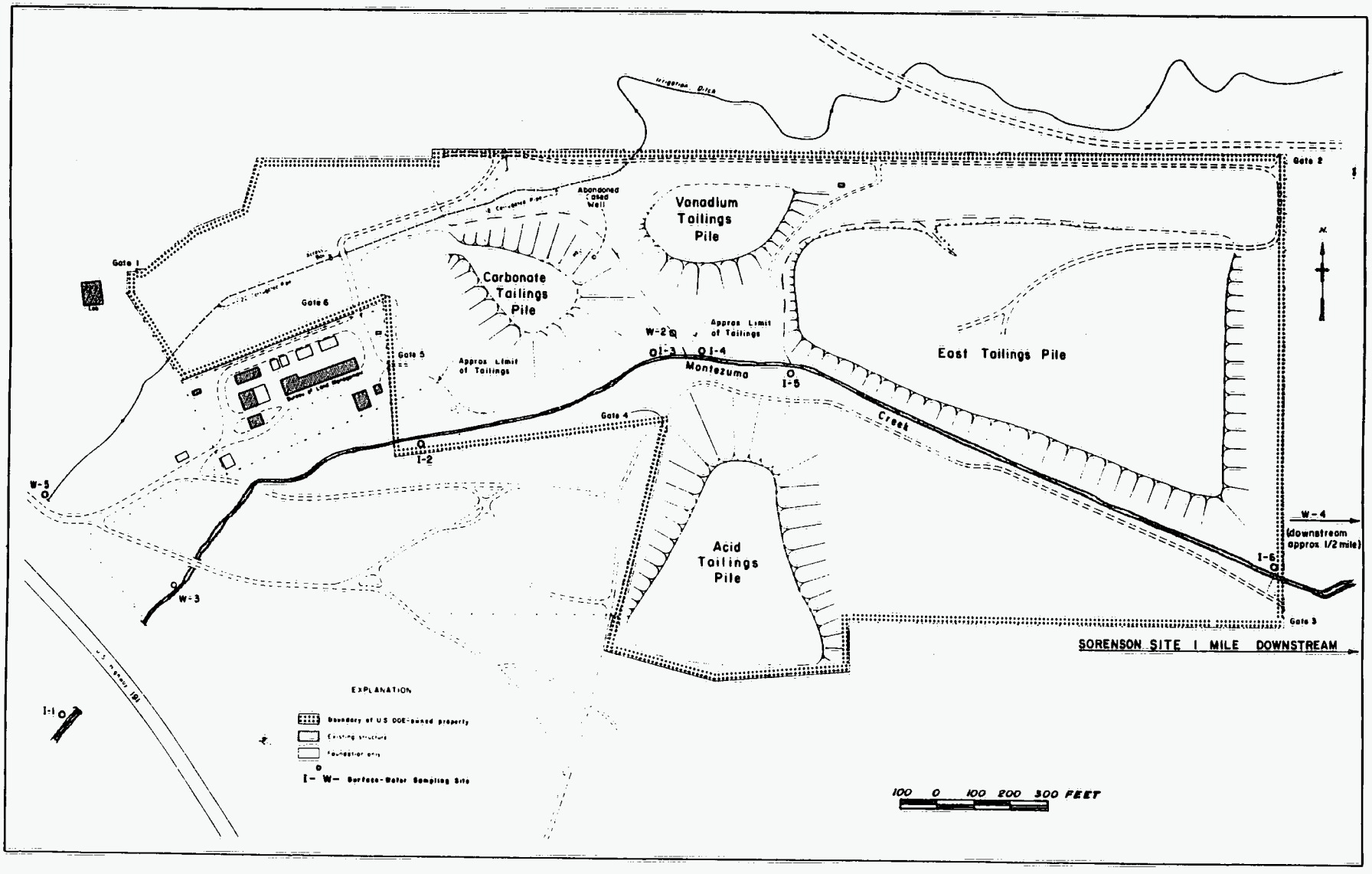

Figure 4. Locations of Surface-Water Sampling Sites at the Monticello Millsite.

area as large as 4.5 square meters (5 square yards) to a depth of 15 to 30 centimeters (8 to 15 inches). The Acid Pile seep is contained by a small dam and, when full, is approximately four times larger in area than the Vanadium Pile seep.

The seep adjacent to the Carbonate Pile forms a small pond covering approximately 12.5 square meters (15 square yards). This pond contains water throughout the summer and supports a few cattails; typically, it is the only one of the three seeps that contains water during the dry seasons.

A diversion ditch was constructed north of the East Tailings Pile in 1984 in an attempt to divert some water away from the piles and thereby decrease the volume of contaminated water that seeps out of the piles. Visual observations during 1985, however, did not indicate any decrease in water in the various seeps and small drainages that surround the piles.

Montezuma Creek flows through the middle of the property. As mentioned earlier, flow is perennial, although it can be quite low during the late summer. There can also be substantial flooding, as occurred in the spring of 1983. Results of previous studies (Korte and Thul, 1982, 1983) indicate that uranium contamination of the creek occurs prior to the point at which the creek traverses the tailings piles. However, concentrations of both molybdenum and uranium are typically higher downgradient and off site, which demonstrates that contributions from the alluvial aquifer to Montezuma Creek are greatest downstream of the Government property. The 1988 sampling was conducted on Montezuma Creek, the diversion ditch, and the Vanadium seep (past years of sampling have documented well the contamination in the various seeps adjacent to the tailings piles). The results of the analyses of these samples are shown in the Appendix.

Seeps from the shallow aquifer are visible along the creek below the drop structure. Creek flow increases for approximately 2 kilometers (1.25 miles) and is perennial along this stretch. The W-4 sampling site is located approximately 100 meters (325 feet) downstream of the east boundary of the property. Except under conditions of very high flow, as during a storm event or spring runoff, contamination levels frequently exceed State of Utah standards.

Samples have routinely been collected at what is known as the Sorenson site, located approximately 2 kilometers (1.25 miles) downstream of the Government property. Data comparison has shown little decrease in contamination between the W-4 site and the Sorenson site. The shallow aquifer is contaminated as far downgradient as it has been sampled. It is in hydraulic connection with Montezuma Creek and thus maintains high concentrations of the contaminants in the creek for a considerable distance off site. The downstream water quality of Montezuma Creek is described in detail in the 1983 Environmental Monitoring Report (Korte and Thul, 1984) and in the Draft RI (UNC Geotech, 1988a).

Comparison to Standards

A comparison of data from surface-water samples collected from 1984-1988 to State of Utah Surface Water Standards is presented in Table 5. As previously discussed, concentrations of arsenic, gross alpha, Ra-226, nitrate, selenium, silver, sulfate, and zinc in Montezuma Creek have exceeded State standards.

Table 5. Comparison of Maximum Concentrations[a] of Selected Constituents in Montezuma Creek with State of Utah Surface Water Standards

Constituent	Utah Standard	Montezuma Creek Maximum Concentrations[b]			Standard Exceeded? (Yes/No)
		Upgradient	On-Site	Downgradient	
Arsenic	0.05	<0.01[c]	3.5	0.027	Yes
Barium	1.0	<0.10	0.85	0.12	No
Cadmium*	0.010	<0.001	<0.001	<0.001	No
Chromium*	0.05	<0.005	<0.005	<0.005	No
Fluoride*	1.4-2.4	<1.0	<1.0	<1.0	No
Gross Alpha (pCi/L above background)	15	17	991	262	Yes
Iron	1.0	0.10	0.30	0.15	No
Lead*	0.01	0.003	0.003	0.001	No
Mercury*	0.002	<0.002	<0.002	<0.002	No
Nitrate	1.0	3.0	390.0	10.0	Yes
Radium 226 (pCi/L)	5		23.8		Yes
Radium 228 (pCi/L)	5	<1.0	<1.0	<1.0	No
Selenium	0.05	<0.01	3.11	0.04	Yes
Silver*	0.01	<0.0005	0.016	0.002	Yes
Sulfate	1000	190	4200.0	786	Yes
Zinc	0.05	1.02	0.33	1.46	Yes
pH (S.U.)	6.5-9.0	8.6	10	8.6	Yes

[a]Data are from 1984-1988 samplings except those for constituents labeled with an asterisk (*), which are from samplings prior to 1984.

[b]All values are in milligrams per liter (mg/L) except where designated otherwise.

[c]A "<" symbol indicates the maximum concentration was below detection limits (number shown is detection limit).

AIR QUALITY

Atmospheric Radon

Environmental radon measurements were taken at the Monticello site in 1984. The measurements were taken on the pile, at the site boundary, and at off-site locations using Terradex Track Etch® detectors exposed in duplicate, located 0.9 meter (3 feet) above ground level. Atmospheric radon continues to be monitored with Track Etch® detectors, although the number of sample locations has been reduced from 19 to 8 since the conclusion of the 1984 sampling period (Figure 5). The annual average radon concentrations measured during 1988 are listed in Table 6 (pg. 20). During this more recent measurement period, the annual average radon standard specified by 40 CFR 192 was exceeded at ST-4, ST-6, and ST-7. These values are consistent with the previous years' annual averages, which indicates a constant rate of radon emission from the piles. The radon emission described in the following section, although measured in a previous year, can be considered representative of the 1988 monitoring period.

Radon Emission

Extensive measurements of radon flux from the tailings piles were taken during 1984; results of these measurements are presented in detail in the Draft EA (UNC Geotech 1988b). The data demonstrate that the EPA standard of 20 $pCi \cdot m^{-2} \cdot sec^{-1}$ for radon emission from inactive uranium processing sites is exceeded at all four tailings piles at the Monticello site.

The radon source strength, area, and weighted average radon flux for each tailings pile are presented in Table 7.

Table 7. Radon Source Strength, Area, and Weighted Average Radon Flux for the Monticello Tailings Piles

Tailings Pile	Radon Source Strength (Ci/Yr)	Area (m^2)	Weighted-Average Radon Flux ($pCi \cdot m^{-2} \cdot sec^{-1}$)
Acid Pile	512.7	52,070	312
Carbonate Pile	571.1	23,657	765
Vanadium Pile	88.5	16,216	173
East Pile	401.9	95,746	133
Total	1574.2		

Table 6. Summary of Radon Concentrations for the Monticello Area for the Period of 20 November 1987 through 16 November 1988

Sampling Location	Radon Concentration (pCi/L)[a]				
	Annual Average	First Quarter[b]	Second Quarter[c]	Third Quarter[d]	Fourth Quarter[e]
ST-4	1.3	0.4	0.8	2.1	1.8
ST-6	2.6	0.3	0.7	8.4	1.0
ST-7	1.4	1.3	0.9	2.3	1.2
ST-10	0.2	0.1	0.5	0.3	0.2
ST-11	0.2	0.04	0.4	0.2	0.1
ST-13	0.4	f	0.5	0.5	0.3
ST-14	0.2	0.1	0.3	0.2	0.1
ST-15	0.4	0.1	0.4	0.5	0.5

[a] The units are reported as pCi/L to be consistent with the EPA standard 40 CFR part 192. To convert pCi/L to μCi/ml, multiply by 1×10^{-9}.

[b] 20 November 1987 through 24 February 1988.

[c] 24 February 1988 through 25 May 1988.

[d] 25 May 1988 through 16 August 1988.

[e] 16 August 1988 through 16 November 1988.

[f] ST-13 was found destroyed in the field.

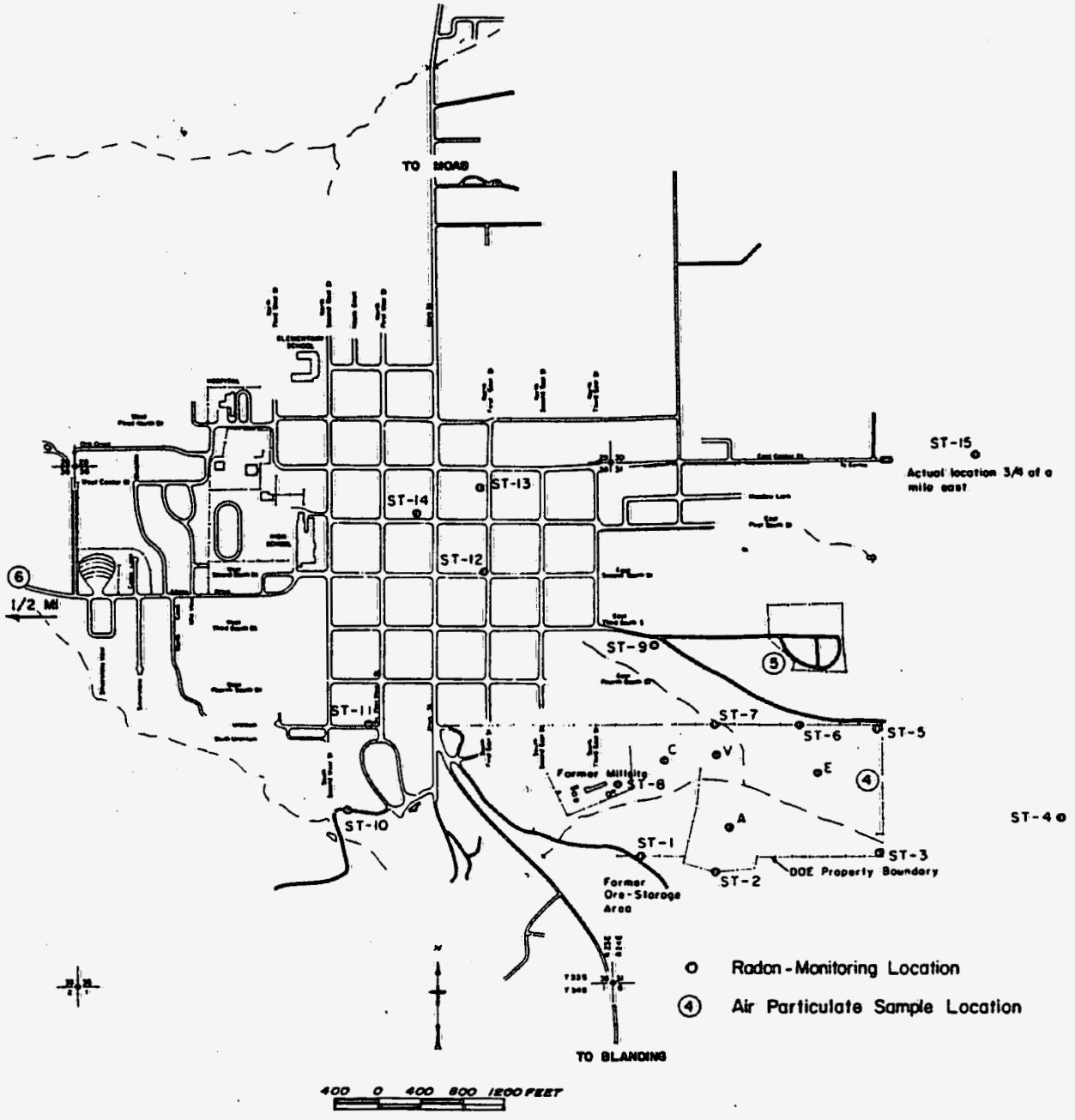

Figure 5. Sampling Locations for Radon and Air Particulate Monitoring in the Monticello Study Area.

Air Particulates

Inhalable particulate samplers based on the design by Wedding (1982) were installed at the Monticello site. The samplers are Sierra-Anderson Series 300 and are equipped with constant-flow controllers, mechanical timers, and Series-320-size selective inlets. Flow-rate calibration is accomplished with a Kurz Model 341 electronic mass flow meter.

Samplers are operated at 1133 liters per minute (Lpm) (40 cubic feet per minute) for 24 hours, running midnight-to-midnight every sixth day. Sample-collection media are Whatman Number 41 cellulose filters.

Wind-rose data collected on site have clearly identified two principal wind vectors in the area, one to the east and one to the north. Thus, sampling stations were located along these two directions as well as at a background site (Figure 5).

The background site is located approximately 0.5 kilometer (0.3 mile) west of the city of Monticello near the pumphouse building for the city water supply. The intake port for this sampler is 3 meters (10 feet) above ground level. The area west of this site is mostly natural desert and mountainous terrain. There are no nearby industrial activities.

The east site is located on the eastern edge of the East Tailings Pile. The sampler was placed on a steel tower such that the intake was mounted approximately 3 meters (10 feet) above ground level.

The north site is located on the west side of the City of Monticello cemetery grounds. This location is 30 meters (100 feet) north of the tailings area at an elevation 100 meters (330 feet) above the piles. The sampler intake is 4 meters (13 feet) above ground level.

Air-particulate sampling was conducted 13 April through 10 November 1988. (Sampling was suspended prior to 13 April and after 10 November because of inclement weather.) Eighty-three samples were collected in 1988. In Table 8 are listed, for all selected elements, maximum concentrations and mean concentrations above detection limits (ADL) measured during the 1988 sampling program.

Comparison to Standards

The EPA standard (40 CFR Part 192) for atmospheric radon concentration at the edge of an inactive uranium mill tailings pile is 0.50 pCi/L above background. If 0.41 pCi/L is used as the average annual background for Monticello (UNC Geotech, 1988a), the site-specific EPA standard is calculated to be 0.91 pCi/L. Examination of the data in Table 6 reveals that the EPA standard is exceeded at both edge-of-pile locations (ST-6 and ST-7). The only off-site location exceeding the standard is ST-4.

Radiologic air particulate levels are regulated at the Monticello site by DOE Order 5480.1; the standards applicable to Monticello are given as concentrations above natural background. The reported limits for an uncontrolled area, averaged over one year, are 3×10^{-12} µCi/ml radium-226, 8×10^{-14} µCi/ml thorium-230, and 3×10^{-12} µCi/ml natural uranium. Examination of

Table 8. Results of Monticello Air Particulate Study Conducted During 1988

Element	Maximum Concentration			Annual Average Concentration[a]			Number of Samples[b]		
	Station 4 East	Station 5 North	Station 6 B.G.	Station 4 East	Station 5 North	Station 6 B.G.	Station 4 East	Station 5 North	Station 6 B.G.
RADIOACTIVE ELEMENTS									
Uranium ($\mu g/m^3$)	c	c	c	c	c	c	23(0)	24(0)	23(0)
($\mu Ci/ml$)	c	c	c	c	c	c			
Radium-226 ($\mu Ci/ml$)	4.2×10^{-16}	2.1×10^{-16}	1.6×10^{-16}	1.5×10^{-16}	1.2×10^{-16}	1.4×10^{-16}	18(6)	18(4)	19(2)
Thorium-230 ($\mu Ci/ml$)	2.3×10^{-16}	1.2×10^{-16}	9.2×10^{-17}	1.0×10^{-16}	9.3×10^{-17}	7.2×10^{-17}	26(8)	26(4)	27(6)
NONRADIOLOGIC ELEMENT									
Lead ($\mu g/m^3$)	0.007	0.006	0.005	0.002	0.002	0.002	23(20)	24(21)	23(21)

[a]Average is calculated using only those values above the minimum detection limit.
[b]Number in parentheses indicates number of samples above detection limit.
[c]All values were below the detection limit. The average detection limits are 0.0006 $\mu g/m^3$ uranium and 1.6×10^{-16} $\mu Ci/ml$ uranium.

Table 8 shows the highest annual average concentrations of the subject elements (inclusive of background levels) to be 1.5×10^{-16} µCi/ml radium-226, 1.0×10^{-16} µCi/ml thorium-230, and less than 2×10^{-16} µCi/ml natural uranium, values that are clearly below the standard.

Lead is the only nonradioactive airborne particulate measured at the Monticello Facility that is regulated by a specific standard. Acceptable levels of this element are defined by the EPA under the National Ambient Air Quality Standards (NAAQS). The standard specifies that a 3-month average concentration of lead is not to exceed 1.5 µg/m^3. The maximum concentration measured at the site is 0.006 µg/m^3 (see Table 8), a level clearly below the compliance standard.

ENVIRONMENTAL COMPLIANCE ACTIVITIES

The Monticello Millsite is non-operational and as a result does not have operational environmental requirements. Items related to planned remediation activities at the Monticello Millsite that necessitate regulatory involvement are discussed below.

ENVIRONMENTAL MONITORING REPORT

An Environmental Monitoring Report for calendar year 1987 was submitted in 1988 for the Monticello site. The report was accepted by DOE-ID.

HAZARD RANKING SYSTEM (HRS) SCORE

The Monticello Millsite was scored using the Hazard Ranking System (HRS) for possible inclusion on the Superfund National Priority List (NPL). A score of 28.5 is required for inclusion. The internal evaluation resulted in a score of 52.0 for the millsite, a score which was submitted to the EPA Region VIII on 31 October 1987. In 1988, the submittal underwent evaluation by the EPA for accuracy and completeness. Results of EPA's review are expected in 1989.

RI/FS SUBMITTAL

The *Draft Remedial Investigation/Feasibility Study for the Monticello Uranium Mill Tailings Site, Monticello, Utah,* (UNC Geotech 1988a) and the *Draft Environmental Assessment of Remedial Action at the Monticello Uranium Mill Tailings Site, Monticello, Utah* (UNC Geotech 1988b) were submitted to the DOE in January. To further characterize the site and assess potential impacts of remedial action, additional investigations of the flora, aquatic life, and cultural resources of Montezuma Creek and peripheral properties were conducted in the summer (Western Resource Development Corporation 1988; Bio/West, Inc. 1988; Grand River Institute 1988).

FEDERAL FACILITY AGREEMENT

Work continued throughout the year in support of the preparation of an Interagency Agreement (IAG). A DOE/EPA IAG in the form of a Federal Facility Agreement (FFA) was signed 21 December 1988.

SUMMARY OF POTENTIAL HEALTH EFFECTS

A quantitative assessment of the potential health effects associated with tailings-related contamination is presented in the Draft RI/FS (UNC Geotech 1988a). The assessment is based mostly on site-specific data collected from 1981 through 1987. The monitoring data collected in 1988, although more limited in scope, indicate that the ground water and atmospheric radon concentrations are relatively consistent with previous years' values. In view of this, and because there were no operational activities at the site in 1988 that would be expected to cause a significant increase in the source terms, a risk assessment based on the 1988 monitoring data was not undertaken. The following risk estimates, summarized from the Draft RI/FS, are therefore considered to be representative of the site during 1988.

The population doses to the approximately 2469 Monticello residents from natural background radiation and from the tailings piles in their present condition are listed in Table 9. The data demonstrate that the major contributor to the overall risk to Monticello residents from the tailings piles is natural background radiation.

Table 9. Population Dose Commitments to Monticello Residents from Natural Background and Present Enhanced Conditions

Source	Dose Commitment (man-rem per year)	
	Whole Body	Lung
NATURAL BACKGROUND		
Direct External Exposure	316	
Radon Daughters		1265
ENHANCED CONDITIONS		
Direct External Exposure	0	
Radon Daughters		188

Population dose commitments and potential toxic effects of nonradiologic contaminants associated with the Monticello site are discussed in the Draft RI/FS (UNC Geotech 1988a). Although contaminant levels are low, there remains some potential for adverse health effects resulting from chance exposure to nonradiologic contaminants found in Montezuma Creek and soils on the floodplain. However, there have been no incidents reported. The potential for toxicity was derived from a comparison of contaminant levels with acceptable intakes for chronic exposure (AICs).

When average soil concentrations were used, none of the dose levels was exceeded, which indicates that there is no apparent need for concern. When maximum soil concentrations were used, copper, uranium, and zinc exceeded the recommended limits for children. However, because of the low population densities along the Montezuma Creek drainage and the land use patterns in the area, it is unlikely that individuals would receive chronic exposures to these maximum concentrations.

Several elements found in Montezuma Creek regularly exceed State and Federal water quality standards: selenium, zinc, manganese, arsenic, and molybdenum. The potential for exposure to these elements dictates that this water should not be used for drinking by humans or cattle. Use of this water to irrigate the alfalfa on which cattle graze appears to be acceptable because average exposure doses do not exceed AICs. However, it is recommended that vegetables not be grown in the Montezuma floodplain.

SUGGESTED EXTERNAL DISTRIBUTION LIST

Federal Elected Officials

U.S. Senators

Senator Orrin G. Hatch
3438 Federal Office Bldg.
125 South State Street
Salt Lake City, Utah 84138
(801) 524-4380

Senator Jake Garn
4225 Wallace F. Bennett Federal Office Bldg.
125 South State Street
Salt Lake City, Utah 84138
(801) 524-5933

U.S. Congressman

Representative Howard Nielson - District 3
Room 1 - 92 East Center Street
Moab, Utah 84532
(801) 259-7188

State Elected Officials

Governor Norman Bangerter
State Capitol
Salt Lake City, Utah 84138

Representative David Adams
P.O. Box 429
Monticello, Utah 84535

Local Officials

City of Monticello
22 West Third South Street
Monticello, Utah 84535
(801) 587-2271

City Manager - Rick Terry

Mayor - Ernest J. Sonderegger
City Council:
Rye Nielson
Lee Nielson
Joe Slade
Winn Westcott
Bernie Christensen

County Officials

San Juan County Commission
117 South Main Street
Monticello, Utah 84535
(801) 587-2231

County Commissioners:
Calvin Black
Ken Bailey
Mark Maryboy

State and Local Agencies

Larry Anderson
Director, Bureau of Radiation Control
Division of Environmental Health
State of Utah Health Department
1460 West 228 North
Salt Lake City, Utah 84116
(801) 533-6734

Brent C. Bradford
Director, Bureau of Solid & Hazardous Waste
State of Utah Health Department
1460 West 228 North
Salt Lake City, Utah 84116
(801) 538-6170

Gregg Adams
Southeastern Utah Health District
P.O. Box 127
Monticello, Utah 84535
(801) 587-2021

F. U.S. EPA Region VIII Officials

Address: EPA - Region VIII
1 Denver Place
999 Eighteenth Street, Suite 1300
Denver, Colorado 80202

Robert Duprey, Director
Waste Management Division
FTS 564-1519 or (303) 293-1519

Marily Null
Superfund Community Relations Coordinator
Office of Public Affairs
FTS 327-5927 or (303) 837-5927

William J. Geise, Jr.
Chief, Superfund Branch
FTS 564-1519 or (303) 2931519

C. Jay Silvernale
Superfund Branch
FTS 564-1649 or (303) 293-1649

Lam Nguyen
Superfund Branch
FTS 564-1536 or (303) 293-1536

Media

San Juan Record
737 East Highway 666
Monticello, Utah 84535

KUTA TV
North Highway 191
Blanding, Utah 84511
(801) 678-2261

KMOB Radio
840 South Mill Creek Drive
Moab, Utah 84532

Information Repository

San Juan County Public Library
80 North Main Street
Monticello, Utah 84535
(801) 587-2281

Meeting Locations

Monticello City Hall
33 West First South Street
Monticello, Utah 84535
(801) 587-2271

City Pavilion/County Library
80 North Main Street
Monticello, Utah 84535
(801) 587-2281

San Juan County Courthouse
117 South Main Street
Monticello, Utah 84535
(801) 587-2231

REFERENCES CITED

Abramiuk, I. N., L. A. Blanchfield, E. T. Cotter, H. L. Fleischhauer, C. S. Goodknight, V. G. Johnson, K. E. Karp, P. M. Kearl, N. E. Korte, C. A. Ridolfi, R. R. Roquemore, D. W. Schaer, J. M. Sewell, 1984. *Monticello Remedial Action Project Site Analysis Report*, GJ-10. Prepared for the U.S. Department of Energy, Surplus Facilities Management Program, Richland, Washington.

Albrethsen, H., Jr., and F. E. McGinley, 1982. *Summary History of Domestic Uranium Procurement under U.S. Atomic Energy Commission Contracts, Final Report*, Open-File Report GJBX-220(82). U.S. Department of Energy, Grand Junction Area Office.

Allen, E.S., and J. Klemenic, 1954. An economic study of the Monticello carbonate leach mill. Unpublished report prepared for the U.S. Atomic Energy Commission, dated November 26.

Bio/West, Inc., 1988. An aquatic biology survey of Montezuma Creek, Utah, WM-M-88-4. MS on file at UNC Geotech, Grand Junction.

Grand River Institute, 1988. Cultural resources inventory report on the Monticello Remedial Action Program 1988, peripheral properties and Montezuma Creek, in San Juan County, Utah, WM-M-88-3. MS on file at UNC Geotech, Grand Junction.

Korte, Nic, and Ralph Thul, 1982. *1981 Environmental Monitoring Report--U.S. Department of Energy Facilities, Grand Junction, Colorado, and Monticello, Utah*, BFEC-1982-4. Bendix Field Engineering Corporation, Grand Junction Operations, Grand Junction.

_____, 1983. *1982 Environmental Monitoring Report--U.S. Department of Energy Facilities, Grand Junction, Colorado, and Monticello, Utah*, GJO-113(83). Bendix Field Engineering Corporation, Grand Junction Operations, Grand Junction.

_____, 1984. *1983 Environmental Monitoring Report--U.S. Department of Energy Facilities, Grand Junction, Colorado, and Monticello, Utah*, GJO-113(84). U.S. Department of Energy, Grand Junction Office, Grand Junction.

Marutzky, S. J., Callie Ridolfi, David Traub, Susan Knutson, and B. W. Walker, 1985. *Radiologic Characterization of the Peripheral Properties Adjacent to the Monticello, Utah, Millsite*, GJ-26. U.S. Department of Energy, Grand Junction Projects Office, Grand Junction.

UNC Geotech, 1986. *Environmental Sciences Procedures Manual: Second Edition.* UNC Waste Management Programs, Grand Junction (internal document).

UNC Geotech, 1987a. Quality Assurance Manual. UNC Manual-101. UNC Quality Assurance Department, Grand Junction.

_____, 1987b. Quality Assurance Program Plan (QAPP) for the Monticello Remedial Action Project. UNC Quality Assurance Department, Grand Junction (internal document).

_____, 1988a. *Draft Remedial Investigation/Feasibility Study for the Monticello Uranium Mill Tailings Site, Monticello, Utah*, UNC/GJ-MRAP-2. Prepared for the U.S. Department of Energy, Surplus Facilities Management Program.

_____, 1988b. *Draft Environmental Assessment of Remedial Action at the Monticello Uranium Mill Tailings Site, Monticello, Utah*, DOE/EA-. Prepared for the U.S. Department of Energy, Surplus Facilities Management Program.

_____, 1988c. Handbook of Analytical and Sample-Preparation Methods. UNC Analytical Chemistry Laboratory, Grand Junction (internal document).

_____, 1988d. 1988 Administrative Plan and Quality Control Methods. UNC Analytical Chemistry Laboratory, Grand Junction (internal document).

Western Resource Development Corporation, 1988. Monticello remedial action project, peripheral properties vegetation survey, 1988, San Juan County, Utah, WM-M-88-6. MS on file at UNC Geotech, Grand Junction, Colorado.

Whitman, A., and R. G. Beverly, 1958. *Radium Balance in the Monticello Acid R.I.P. Uranium Mill*, WIN-113. U.S. Atomic Energy Commission, Raw Materials Development Laboratory.

APPENDIX

1988 Water Chemistry Data for the Monticello Millsite

1988 Water Chemistry Data for Monticello Millsite

WELL ID	SAMPLE DATE	ALKY (mg/L) (as $CaCO_3$)	ALPHA (pCi/L)	AS (mg/L)	BETA (pCi/L)	CDT (µmho/cm)	DTW (feet)	MO (mg/L)	NO_3 (mg/L)	PH	RA-226 (pCi/L)	RA-228 (pCi/L)	SE (mg/L)	TEMP °C	U (mg/L)	V (mg/L)
82-08	04/18/88	422	127	<0.005	<77	2915	9.52	<0.05	0.7	6.47	0.3	<0.8	<0.005	No Data	0.176	<0.05
82-09	04/18/88	318	334	<0.005	176	1699	5.6	0.107	5.5	7.18	0.4	<1.3	0.007	No Data	0.622	<0.05
82-13	04/18/88	333	206	<0.005	245	1754	5.27	<0.05	<0.2	6.72	<0.1	<0.9	<0.005	No Data	0.395	<0.05
82-20	04/18/88	36	<48	<0.005	<77	2696	16.55	<0.05	143	6.63	0.1	<1.2	0.006	No Data	0.012	<0.05
82-30B	04/18/88	435	319	0.112	121	2059	16	0.351	0.7	7.21	0.4	<0.7	0.073	No Data	0.612	4.29
82-31B-EAST	04/18/88	340	<49	<0.005	<77	2978	5.45	<0.05	90.9	6.68	0.3	<1.5	<0.005	No Data	0.022	<0.05
82-36A	04/18/88	760	2919	<0.005	575	679	43.35	1.23	101	6.97	19.4	<2.8	<0.005	No Data	9.69	<0.05
82-40A	04/18/88	405	486	0.041	155	1707	20.5	0.225	<0.2	7.01	2.8	<1.8	<0.005	No Data	0.871	0.523
82-43	04/18/88	295	<46	<0.005	<76	2310	8.5	<0.05	51.1	6.63	0.1	<0.7	<0.005	No Data	0.02	<0.05
82-45B	04/18/88	283	13	<0.005	<15	1264	3.9	<0.05	4.4	6.89	0.4	<1.2	<0.005	No Data	0.026	<0.05
82-45B (DUP)	04/18/88	No Data	37	<0.005	<15	No Data	No Data	<0.05	4.2	No Data	0.4	<1.4	<0.005	No Data	0.026	<0.05
82-51	04/18/88	418	54	<0.005	<26	1540	9	<0.05	<0.2	6.97	0.3	<0.7	<0.005	No Data	0.065	<0.05
82-52	04/18/88	353	77	0.013	<26	1639	19.75	<0.05	<0.2	6.86	0.2	<0.9	<0.005	No Data	0.093	<0.05
83-74	04/18/88	208	10	<0.005	<8	584	63.55	<0.05	<0.2	7.6	1.6	<1.2	<0.005	No Data	<0.001	<0.05
MONTEZUMA	04/18/88	303	<18	<0.005	<26	1487	No Data	<0.05	1.2	8.48	0.3	<1.2	<0.005	No Data	0.026	<0.05
N. DRAINAGE	04/18/88	298	107	<0.005	32	1493	No Data	<0.05	10.1	7.95	3.7	<1.2	<0.005	No Data	0.199	<0.05
N. DRAINAGE (DUP)	04/18/88	No Data	140	<0.005	26	No Data	No Data	<0.05	10	No Data	3.6	<1.2	<0.005	No Data	0.197	<0.05
SORENSON	04/18/88	285	136	<0.005	27	1794	No Data	<0.05	24.5	7.81	0.6	<0.8	0.007	No Data	0.219	0.125
SEEP AT VANADIUM PILE	04/18/88	2150	24303	4.95	14801	10292	No Data	4.33	<0.2	9.97	<0.3	<2.7	1.52	No Data	41.5	317
W-2	04/18/88	650	1164	1.58	318	5994	No Data	4.02	71	9.42	7.1	<1.8	1.27	No Data	1.79	67.4
W-3	04/18/88	161	<9	<0.005	<10	936	No Data	<0.05	5.8	7.9	<0.2	<0.6	<0.005	No Data	0.005	<0.05
W-4	04/18/88	261	51	<0.005	<26	1681	No Data	<0.05	28.1	7.88	0.4	<1	<0.005	No Data	0.082	0.167

1988 Water Chemistry Data for Monticello Millsite (continued)

WELL ID	SAMPLE DATE	ALKY (mg/L) (as $CaCO_3$)	ALPHA (pCi/L)	AS (mg/L)	BETA (pCi/L)	COT (µmho/cm)	DTW (feet)	MO (mg/L)	NO_3 (mg/L)	PH	RA-226 (pCi/L)	RA-228 (pCi/L)	SE (mg/L)	TEMP °C	U (mg/L)	V (mg/L)
82-08	10/17/88	380	40	<0.005	<26	2810	10.43	<0.05	4.1	6.6	0.3	<1.1	0.006	12.9	0.11	<0.05
82-09	10/17/88	395	265	<0.005	147	2060	5.46	0.13	0.7	6.92	0.4	<1.4	<0.005	12.5	0.71	<0.05
82-13	10/17/88	387	251	<0.005	96	2900	4.72	<0.05	0.2	6.47	0.1	<1.1	<0.005	11.7	0.57	<0.05
82-20	10/17/88	383	<30	<0.005	<26	3240	17.05	<0.05	219	6.76	0.1	<1	0.01	8.2	0.014	<0.05
82-30B	10/17/88	431	354	0.19	128	2120	17.4	0.36	No Data	7.2	0.5	<1.4	0.062	10.4	0.59	4.1
82-31B-EAST	10/17/88	440	39	<0.005	<39	3290	4.23	<0.05	27	6.72	0.2	<1.1	<0.005	11.8	0.022	<0.05
82-36A	10/17/88	749	1801	0.009	627	7390	42.79	0.89	No Data	7	9.8	<2.9	<0.005	10.1	0.83	0.34
82-40A	10/17/88	403	493	0.058	183	2030	21.42	0.2	0.2	6.96	3.1	<2.1	<0.005	10.6	0.83	0.5
82-43	10/17/88	346	<26	<0.005	<20	2760	9.08	<0.05	125	6.8	<0.1	<1.3	<0.005	10.2	0.022	<0.05
82-45B	10/17/88	322	<13	<0.005	14	1470	4.1	<0.05	21.9	6.68	0.6	<1.3	<0.005	11.8	0.29	<0.05
82-45B (DUP)	10/17/88	322	<15	<0.005	<19	1470	4.1	<0.05	0.2	6.68	0.5	<1.3	<0.005	11.8	0.03	<0.05
82-51	10/17/88	376	32	<0.005	<10	1430	9.8	<0.05	0.1	6.75	0.5	<1	<0.005	10	0.052	0.056
82-52	10/17/88	371	40	0.017	21	1530	21.13	<0.05	0.2	6.95	0.7	<1	<0.005	10.6	0.081	<0.05
83-74	10/17/88	209	11	<0.005	<8	612	62.67	<0.05	0.2	7.6	1.4	<1.2	<0.005	11.6	<0.003	<0.05
MONTEZUMA	10/17/88	164	35	<0.005	18	1490	No Data	<0.05	5.6	8.06	0.3	<0.9	<0.005	13.7	0.079	<0.05
N. DRAINAGE	10/17/88	330	25	<0.005	<15	994	No Data	<0.05	6.7	8.43	2.2	<1.5	<0.005	12.8	0.067	<0.05
SEEP AT CARBONATE PILE	10/17/88	407	1286	1	404	2390	No Data	0.35	0.3	8.62	7.7	<2.4	0.033	13.2	1.6	0.35
SORENSON	10/17/88	232	82	<0.005	29	1870	No Data	<0.05	32.2	8.1	0.5	<0.6	<0.005	15	0.15	0.074
M-2	10/17/88	194	1073	3	385	9070	No Data	5.7	115	9.7	6.9	<1.5	1.8	15.6	0.92	91
M-3	10/17/88	214	<20	<0.005	<16	2210	No Data	<0.05	13.2	8.02	0.1	<0.7	<0.005	11.1	<0.003	<0.05
M-4	10/17/88	256	<21	<0.005	<16	1940	No Data	<0.05	44.3	7.89	0.3	<0.4	<0.005	12.4	0.042	0.12
M-5	10/17/88	390	<12	<0.005	<15	999	No Data	<0.05	1.3	7.68	0.2	<0.9	<0.005	10.5	<0.003	<0.05